AMENDMENTS TO THE CLAIMS

Listing of claims:

This listing of claims replaces all prior versions and listings of claims in the application.

1-57 (Cancelled).

Claim 58 (Currently Amended): An electron beam apparatus for irradiating a sample with a primary electron beam, and detecting a secondary electron beam generated from the sample by the irradiation to evaluate the sample surface, comprising:

an electron gun having a cathode for emitting a primary electron beam;

a lens positioned near said electron gun;

an objective lens for accelerating secondary electrons emitted from the sample;

a beam separator for separating said secondary electrons from a primary electro-optical system and directing them toward a secondary electron detector;

a lens and a deflector for deflecting the secondary electrons between the beam separator and the detector; and

a stage for supporting the sample;

wherein said beam separator is positioned above said objective lens so that the secondary electrons pass through said objective lens and then are deflected and separated from said primary electro-optical

system without entering a lens of said primary electro-optical system, and a magnetic deflector for said beam separator is positioned outside of a vacuum wall.

Claim 59 (Previously Presented): An electron beam apparatus according to Claim 58, wherein said beam separator comprises an electrostatic deflector having six or more electrodes, and a saddle-shaped deflector arranged outside said electrostatic deflector.

Claim 60 (Currently Amended): An electron beam apparatus according to Claim 58, ~~further comprising:~~

~~a speed detector for detecting a moving speed of said stage for carrying the sample thereon; and~~

~~a deflection amount correcting device for correcting the amount of deflection for the primary electron beam in accordance with the moving speed of the stage from said speed detector~~

wherein the deflector is adapted to correct variation of a beam irradiation point on the sample which may occur in accordance with variation of a moving speed of the stage.

Claim 61 (Currently Amended): An electron beam apparatus wherein the deflector is positioned between the lens and the detector ~~for irradiating a sample with primary electron beams, and detecting secondary electron beams generated from the sample by the irradiation to evaluate the sample, comprising:~~

~~an electron gun having a cathode for forming primary electron beams;~~

~~a lens positioned near said electron gun;~~

~~an objective lens for accelerating low energy electrons emitted from the sample;~~

~~a beam separator for deflecting electrons passing through said objective lens toward a secondary electro-optical system;~~

~~a plurality of detectors for detecting the intensity of electrons collected through said secondary electro-optical system to convert the intensity to an electric signal,~~

~~wherein a spacing between irradiation points of the adjacent primary electron beams is set larger than an extending diameter of back scattered electrons on the sample~~.

Claim 62 (Currently Amended): An electron beam apparatus according to Claim [[~~61~~]] 58, wherein multiple beams are used for the primary electron beam ~~the spacing between the adjacent primary electron beams is adjusted by changing a magnification of an electro-optical system from a generation unit of the primary electron beams to the sample~~.

Claim 63 (Previously Presented): An electron beam apparatus for irradiating a sample with a primary electron beam, and detecting a secondary electron beam generated from the sample by the irradiation to evaluate the sample, comprising:

an electron gun having an axial symmetrical cathode for emitting a primary electron beam;

an axial symmetrical lens positioned near said electron gun;

an objective lens for accelerating secondary electrons emitted from the sample; and

a beam separator for deflecting electrons passing through said objective lens toward a secondary electron detector; and

a mechanism for adjusting a beam diameter and a beam current of the primary electron beam to maximize an S/N ratio in a particular pattern in an electric signal of the secondary electron beam detected by said detector, wherein the beam diameter and the beam current are adjusted by changing a brightness of the electron gun, and the electron beam apparatus has a plurality of particular patterns, one of which is selected and used to determine the beam diameter providing the maximum S/N ratio.

Claim 64 (Previously Presented): An electron beam apparatus according to Claim 63, wherein said particular pattern is a line and space pattern having a pitch twice a minimum line width of a pattern on the sample under evaluation.

Claim 65 (Currently Amended): An electron beam apparatus according to Claim 63, further comprising:

~~an irradiation amount detector for detecting the amount of the primary electron beam irradiated to the sample surface; and~~

~~an irradiation amount controller for controlling to prevent the amount of irradiated primary electron beam per unit area from exceeding a previously set predetermined value based on the amount of irradiation obtained from said irradiation amount detector~~

a lens and a deflector between the beam separator and the secondary electron detector.

Claim 66 (Original): An electron beam apparatus according to Claim [[~~63~~]] 65, wherein:

~~said sample is a semiconductor wafer,~~

~~said electron beam apparatus further comprises a device for controlling to evaluate a surface of said semiconductor wafer in units of constant stripe widths while continuously moving said stage, and~~

~~said irradiation amount controller is adapted to control every area smaller than the length in a stripe direction of a chip multiplied by a stripe width~~

the deflector is positioned between the lens and the secondary electron detector.

Claim 67 (Previously Presented): An electron beam apparatus according to Claim 63, further comprising a device for switching a ground voltage and a predetermined voltage for application to a connector connected to an external electrode of the semiconductor wafer.

Claim 68 (Previously Presented): An electron beam apparatus according to Claim 58, further comprising:

a detector for detecting the intensity of electrons collected through a secondary electro-optical system to convert the intensity to an electric signal; and

an image processing unit for processing the electric signal from said detector into image data.

Claim 69 (Previously Presented): An electron beam apparatus according to Claim 63, further comprising:

an image acquisition device for acquiring an image of regions under testing displaced while partially overlapping one another on the sample;

a storage device for storing a reference image; and

a defect determining device for determining a defect on the sample by comparing the image of the regions under testing acquired by said image acquisition device with a reference image stored in said storage device.

Claim 70 (Previously Presented): An electron beam apparatus according to Claim 63, wherein said stage apparatus comprises:

a non-contact supporting mechanism based on a hydrostatic bearing, and a vacuum sealing mechanism based on differential pumping; and

a partition positioned between a location on the sample surface irradiated with the primary electron beam and said hydrostatic bearing support of said stage apparatus, for reducing conductance,

wherein a pressure difference is produced between the electron beam irradiated region and said hydrostatic bearing support.

Claim 71 (Previously Presented): An electron beam apparatus according to Claim 70, wherein at least surfaces of parts of said stage apparatus facing said hydrostatic bearing are subjected to a surface treatment for reducing gas emission.

Claim 72 (Previously Presented): An electron beam apparatus according to Claim 63, wherein

the sample is carried on a stage apparatus which is accommodated in a housing and supported by hydrostatic bearings with respect to said housing in a non-contact manner;

said housing for accommodating said stage apparatus is evacuated; and

said electron beam apparatus further comprises a differential pumping mechanism provided around a portion of said electron beam apparatus for irradiating the sample surface with the primary electron beam for evacuating the irradiated region on the sample surface.

Claim 73 (Previously Presented): An electron beam apparatus according to Claim 72, wherein a gas supplied to said hydrostatic bearings of said stage apparatus is dry nitrogen or highly pure inert gas, said dry nitrogen or said highly pure inert gas being exhausted from said housing

for accommodating said stage apparatus, pressurized, and again supplied to said hydrostatic bearing.

Claim 74 (Previously Presented): An evaluation system for evaluating a sample, comprising:

an electron beam apparatus according to Claim 63;

a working chamber for accommodating a stage apparatus and a primary electron beam irradiating unit of said electron beam apparatus, said working chamber being controllable in a vacuum atmosphere;

a loader for supplying a sample onto said stage apparatus within said working chamber;

a potential applying mechanism disposed within said working chamber for applying the sample with a potential; and

an alignment controller for observing a surface of the sample to control alignment for positioning the sample with respect to an electro-optical system of said electron beam apparatus,

wherein said vacuum working chamber is supported through a vibration isolator for isolating vibrations from a floor.

Claim 75 (Previously Presented): A semiconductor device which is manufactured and evaluated using an electron beam apparatus according to Claim 63 in the middle of or after termination of a manufacturing process.

Claim 76 (Previously Presented): A semiconductor device which is manufactured and evaluated using an electron beam apparatus according to Claim 58 in the middle of or after termination of a manufacturing process.

Claim 77 (Previously Presented): A method of evaluating a sample, using an electron beam apparatus comprising:

preparing a plurality of standard marks having different line and space patterns;

selecting one of standard marks, which has a line and space pattern corresponding to a width of a line on the sample to be evaluated;

irradiating the selected standard mark with a plurality of electron beams having different diameters at a plurality of times, respectively;

detecting secondary electron beams emitted from the selected standard mark at the respective irradiation times to evaluate S/N ratios;

selecting a diameter from the different diameters of the irradiated electron beams, with which a maximum S/N ratio has been obtained in the S/N ratio evaluation;

irradiating said sample with a primary electron beam having the selected beam diameter;

detecting a secondary electron beam generated from the sample by the irradiation; and

evaluating the sample,

wherein said electron beam apparatus comprises:

an electron gun having a cathode for forming a primary electron beam;

a lens positioned near said electron gun;

a beam separator for separating said secondary electron beam from a primary electro-optical system and directing it to a secondary electron detector; and

an objective lens for accelerating said secondary electron beam emitted from the sample,

wherein said beam separator is positioned above said objective lens so that the secondary electron beam passes through said objective lens and then is deflected and separated from said primary electro-optical system without entering a second lens from the sample surface.

Claim 78 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

accelerating said secondary electron beam emitted from the sample by an objective lens; and

deflecting said secondary electron beam to said secondary electron detector by a beam separator which comprises a saddle-shaped deflector arranged outside of a vacuum wall.

Claim 79 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

detecting a moving speed of a stage for carrying the sample thereon; and

calibrating the amount of deflection for the primary electron beam in accordance with the moving speed of the stage detected at the speed detection.

Claim 80 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

adjusting a beam dimension or a beam current of the primary electron beam to maximize a contrast or an S/N ratio in a particular pattern in electric signals of the secondary electron beam detected by said detector.

Claim 81 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

detecting the amount of a primary electron beam irradiated to the sample; and

controlling to prevent the amount of irradiated primary electron beam per unit area from exceeding a previously set predetermined value based on the amount of irradiation obtained by detecting the irradiated amount.

Claim 82 (Previously Presented): A method of manufacturing a semiconductor device, comprising:

preparing a wafer,

processing said wafer; and

evaluating said wafer during the wafer processing, using a method according to Claim 77.

Claim 83 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

comparing an image of a standard pattern for the sample with an actual image of the sample generated by said electron beam apparatus, wherein an image of a particular location on the sample which is expected to suffer defects when a pattern under testing is formed on the sample with a corresponding standard pattern image, or with a pattern image for the sample which is expected to suffer less defects.

Claim 84 (Previously Presented): A method of evaluating a sample according to Claim 77, further comprising:

acquiring a plurality of images of regions under testing displaced while partially overlapping one another on the sample;

storing a reference image; and

determining a defect on the sample by comparing each of the acquired images of the region under testing, with the stored reference image.